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Westslope Cutthroat Trout Restoration in Muskrat Creek, Boulder River Drainage, Montana: Progress Report for Period 1993 to 2000

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Executive Summary

Montana Fish, Wildlife and Parks (FWP), the Bureau of Land Management (BLM), and the Forest Service (FS) are collaborating in an on-going effort to conserve westslope cutthroat trout *Oncorhynchus clarki lewisi* (WCT) in Muskrat Creek, a tributary to the Boulder River, Montana in the Elkhorn Mountains. By 1997 WCT in Muskrat Creek were restricted to a very short segment of the stream (about 2.5 km), primarily within federally managed lands, and nonnative brook trout *Salvelinus fontinalis* outnumbered WCT by about 45:1. In 1998 a wooden crib barrier, to prevent the upstream movement of fish, was constructed at the Forest Service boundary near stream kilometer 10.4. From 1997 to 2000 brook trout from above this constructed barrier were removed via electrofishing, marked with an adipose fin clip (1998 and 1999), and moved below the constructed barrier (in 1997 a temporary barrier was constructed near the site of the permanent crib barrier and later removed after construction of the permanent crib barrier). During 1997 and 1998 WCT captured during electrofishing were moved to the upper portion of the drainage, above a natural waterfall barrier located near stream kilometer 12.9, which was not inhabited by fish. A total of 1,940 brook trout were removed in 1997, 1,469 were removed in 1998, 1,000 were removed in 1999, and 977 were removed in 2000. A total of 48 WCT were moved into the upper drainage in 1997 and another 100 were moved in 1998. No WCT were moved in 1999. Monitoring suggests brook trout removal has increased abundance of WCT in the portion of creek between the two barriers, despite the removal of age 1 and older WCT from this portion of the stream in 1997 and 1998. The WCT re-located above the natural barrier apparently survived and reproduced in the upper basin. None of these re-located WCT have been found below the natural barrier at their original capture sites. During August 1999 a single adipose-clipped brook trout was captured immediately above Nursery Creek (above the constructed crib barrier). At this time we are uncertain if this adipose-clipped brook trout actually was re-located below the barrier and made it upstream (either by jumping the barrier or being moved by human intervention), or if this brook trout had had escaped from a holding pen located just above the mouth of Nursery Creek. Expansion of the WCT population from a weak population occupying about 2.5 km, in sympatry with brook trout that were apparently driving them to extinction, to occupy an additional 6.0 km of habitat above a natural barrier appears to be working. In addition, removal of brook trout from the 2.5 km of habitat immediately above the Forest Service boundary appears to be offering the existing WCT population some relief to increase their numbers in this portion of the stream.

Introduction

Montana Fish, Wildlife and Parks (FWP), the Bureau of Land Management (BLM), and the Forest Service (FS) are collaborating in an on-going effort to conserve westslope cutthroat trout *Oncorhynchus clarki lewisi* (WCT) in Muskrat Creek, a tributary to the Boulder River, Montana in the Elkhorn Mountains. Shepard and Spoon (2000) provided a detailed description of the Muskrat Creek drainage and efforts made to restore westslope cutthroat trout (*Oncorhynchus clarki lewsisi*; WCT) through 1999. By 1997 WCT in Muskrat Creek were restricted to a very short segment of the stream (about 2.5 km), primarily within federally managed lands, and nonnative brook trout *Salvelinus fontinalis* outnumbered WCT by about 45:1. In 1998 a wooden crib barrier, to prevent the upstream movement of fish, was constructed at the Forest Service boundary near stream kilometer 10.4. From 1997 to 2000 brook trout from above this constructed barrier were removed via electrofishing, marked with an adipose fin clip (1998 and 1999), and moved below the constructed barrier (in 1997 a temporary barrier was constructed near the site of the permanent crib barrier and later removed after construction of the permanent crib barrier). During 1997 and 1998 WCT captured during electrofishing were moved to the upper portion of the drainage, above a natural waterfall barrier located near stream kilometer 12.9, which was not inhabited by fish. A total of 1,940 brook trout were removed in 1997, another 1,469 were removed in 1998, and another 1,000 were removed in 1999. A total of 48 WCT were moved into the upper drainage in 1997 and another 100 were moved in 1998. No WCT were moved in 1999.

Past monitoring suggests brook trout removal has increased abundance of WCT in the portion of creek between the two barriers, despite the removal of age 1 and older WCT from this portion of the stream in 1997 and 1998. The WCT re-located above the natural barrier apparently survived and reproduced in the upper basin. None of these re-located WCT have been found below the natural barrier at their original capture sites. During August 1999 a single adipose-clipped brook trout was captured immediately above Nursery Creek (above the constructed crib barrier). At this time we are uncertain if this adipose-clipped brook trout actually was re-located below the barrier and made it upstream (either by jumping the barrier or being moved by human intervention), or if this brook trout had had escaped from a holding pen located just above the mouth of Nursery Creek. Expansion of the WCT population from a weak population occupying about 2.5 km, in sympatry with brook trout that were apparently driving them to extinction, to occupy an additional 6.0 km of habitat above a natural barrier appears to be working. In addition, removal of brook trout from the 2.5 km of habitat immediately above the Forest Service boundary appears to be offering the existing WCT population some relief to increase their numbers in this portion of the stream. This report summarizes efforts made during 2000. Stream flows in 2000 were extremely low due to drought conditions. A wildfire burned some of the Muskrat Creek drainage immediately above the constructed barrier and in the Nursery Creek area.

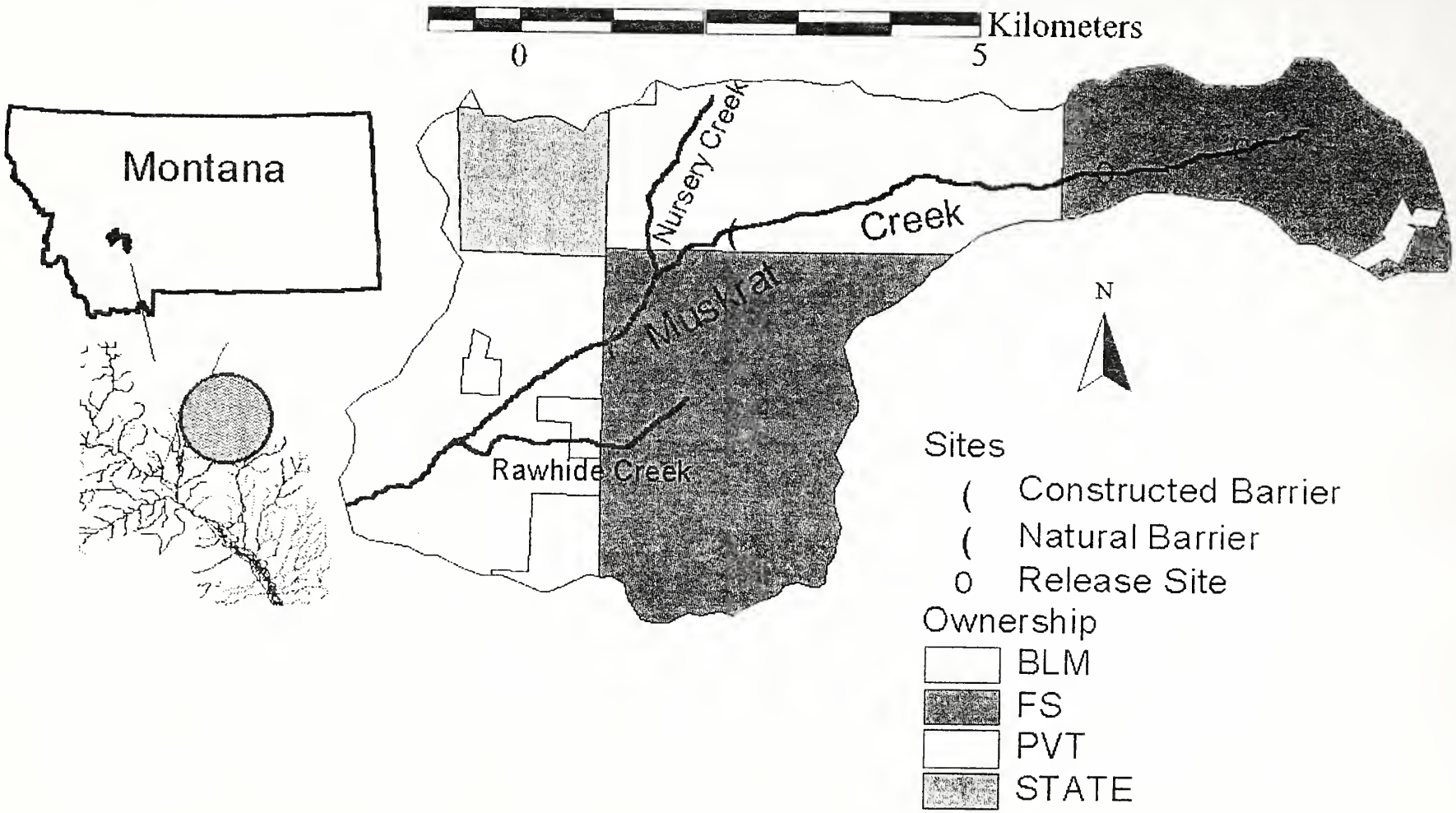

Figure 1. Map of Muskrat Creek showing land ownership, locations of constructed barrier, natural barrier (waterfall), and sites where westslope cutthroat trout were released in 1997 and 1998.

Results and Discussion

In 2000 a total of 976 brook trout were removed (872 < 150 mm in length and 104 ≥ 150 mm) from the 2.5 km portion of Muskrat Creek from the wooden crib fish barrier up to the waterfall and placed below the crib barrier. A single brook trout was found and removed from Nursery Creek. Catches, and removals, of brook trout did not decline for fish < 150 mm at the same rate between 1999 and 2000 had they had between the previous years (Figure 2; closed circles). We are uncertain if the rate of decline will continue to remain relatively level for brook trout < 150 mm, or if it will continue to decline in subsequent years. Rates of decline have remained relatively stable for brook trout 150 mm and longer; however, it appeared that catches were slightly higher in 1999 than they should have been using the the other three years as indicators for rate of removal (Figure 2; open circles). Using a regression equation to estimate when catches brook trout 150 mm and longer would reach zero indicated that by the year 2003 catches of these larger brook trout should reach zero. Since we were less certain of the linear nature for catches of brook trout less than 150 mm we did not report regression results for this size group.

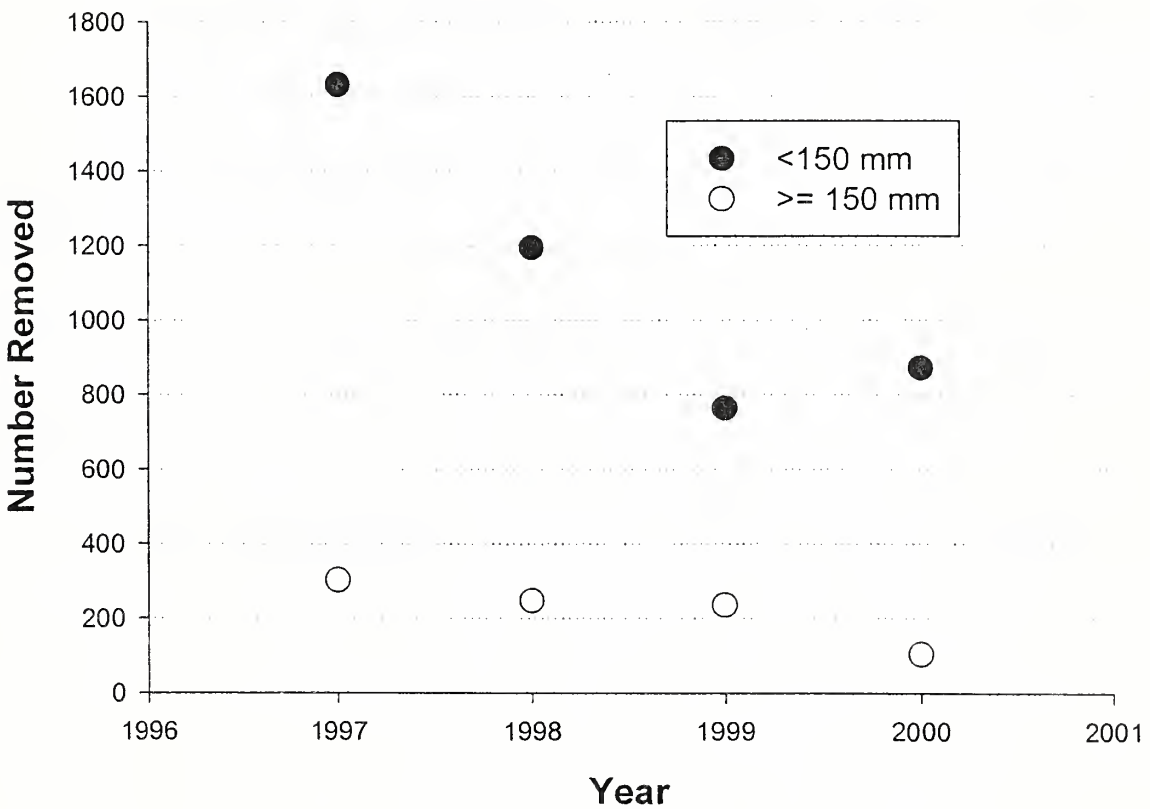

Figure 2. Number of brook trout removed (circles) from the Muskrat Creek drainage from 1997 (year 1) to 2000 (year 4) along with a regression line and regression statistics from a linear regression of the removal data.

Relative catches and population estimates of WCT and brook trout from 1997 to 2000 indicated that removal of brook trout allowed the WCT population to increase during this time period, despite the removal of about 48 WCT in 1997 and another 100 in 1999 to the portion of the stream above the natual barrier (Table 1; Figures 3 and 4; Appendix A). The relative abundance ratio of brook trout to WCT (based on average catches per 100 m for fish 75 mm and longer) has decreased from about 45:1 in 1997 to 9:1 in 1998, 8:1 in 1999, and 4:1 in 2000, even after removing age 1 and older WCT in 1997 and 1998. Summing estimates for WCT across sample sections from the constructed barrier up to the natural barrier indicated that the number of WCT 75 mm and longer increased from a total of 32 fish in 1997 to 173 in 2000 (Table 2). The total number of WCT 75 mm and longer captured in this reach increased from 46 in 1997 to 166 in 2000 (Table 2). We caution that estimates are under-estimates; however, we believe the four- to five-fold increases indicated by both estimates and total fish captured are probably a relatively reliable measure of the true increase in the WCT population. In contrast, the total number of brook trout 75 mm and longer estimated to be in this portion of the creek declined from 1,284 in 1997 to 585 in 2000, a reduction of 55%. Unfortunately, it appeared that the total number of estimated brook trout increased slightly from 1999 (513) to 2000 (585), due to an increase in smaller (< 150 mm) fish.

Length frequencies of brook trout indicated age 0 fish were from 30 to 70 mm in length, while age 1 fish were about 80 to 130 mm long (Figure 5). A very high number of age 0 brook trout were captured in 2000. We hope that these high catches of brook trout, especially age 0 brook trout, in 2000 were related to increased capture efficiences due to low stream flows from the drought conditions and did not reflect a large population increase. Regardless, it appears that the 2000 year-class of brook trout was a relatively strong year-class.

It appeared that age 1 brook trout reached slightly longer lengths in 1999 and 2000 than in either 1997 or 1998 (Figure 5). We are not sure if this apparent increased growth was due to brook trout removal allowing for faster growth, or some other environmental factor(s). Age 0 WCT were under 50 mm, while age 1 fish were 60 to 100 mm long. Length frequency histograms also indicated that age 1 WCT grew faster in 1999 and 2000 than in 1997 and 1998. These length frequencies were based on late summer sampling, so these fish had obtained most of their growth for the year they were sampled. We did not capture any age 0 WCT in 2000, and hope that they had not yet emerged at the time of our sampling. The proportion of captured WCT that were longer than 150 mm, approximately the size when females first mature, was about 50% in 1997 when WCT were first translocated above the natural barrier. This proportion declined to less than 10% in 1998, increased to about 30% in 1999, then dropped to about 17% in 2000. The adults we sampled in 1999 should have spawned in 2000 and we should have sampled WCT fry (< 50 mm) in 2000 if they had emerged prior to our sampling. The lack of WCT fry in our sampling raises a concern that should be closely monitored next year to see if any age 1 WCT show up in our samples.

Table 1. Summary of catches (number in 1 pass) and population estimates of westslope cutthroat (WCT) and eastern brook trout (EBT) 75 mm (3 inch) and longer in Muskrat Creek from 1997 through 1999.

Stream		Length	Catch per 100 m		Estimate per 100 m	
km	Date	(m)	EBT	WCT	EBT	WCT
	1997					
10.5	9/2/1997	200	26	1	50	-
10.7	9/2/1997	200	58	1	77	1
10.9	9/2/1997	200	74	3	92	3
11.1	9/3/1997	265	50	2	65	2
11.4	9/3/1997	200	36	4	67	7
11.6	9/3/1997	200	40	0	65	-
11.8	9/3/1997	200	32	1	47	1
12.0	9/4/1997	240	20	0	-	-
12.2	9/4/1997	240	30	1		
12.5	9/4/1997	200	16	1	44	1
12.7	9/4/1997	235	15	1	53	0
	1998					
10.4	9/8/1998	100	32	4	53	14
10.5	9/8/1998	150	18	7	28	11
10.6	9/8/1998	100	34	8	72	10
10.7	9/8/1998	100	37	8	75	10
10.8	9/8/1998	100	51	8	62	13
10.9	9/8/1998	100	30	2	50	3
11.0	9/8/1998	100	46	14	66	18
11.1	9/8/1998	100	47	3	74	-
11.2	9/8/1998	116	10	0	-	-
11.3	9/8/1998	100	24	2	32	3
11.4	9/9/1998	100	23	1	44	-
11.5	9/9/1998	100	21	1	34	1
11.6	9/9/1998	100	28	2	42	2
11.7	9/9/1998	100	32	2	40	2
11.8	9/9/1998	100	25	1	30	1
11.9	9/9/1998	100	19	0	24	-
12.0	9/9/1998	100	27	2	34	2
12.1	9/9/1998	100	14	0	20	-
12.2	9/9/1998	100	20	1	29	1
12.3	9/9/1998	100	20	0	62	-
12.4	9/9/1998	100	30	0	43	-
12.5	9/9/1998	112	49	2	78	3

Stream km	Date	Length (m)	Catch per 100 m EBT	Catch per 100 m WCT	Estimate per 100 m EBT	Estimate per 100 m WCT
	1999					
10.4	8/23/1999	140	16	1	19	-
10.6	8/23/1999	200	9	4	15	4
10.8	8/23/1999	200	25	3	28	3
11.0	8/23/1999	200	18	2	23	2
11.1	8/24/1999	158	19	1	22	1
11.3	8/24/1999	200	24	2	37	2
11.5	8/24/1999	200	15	1	20	1
11.7	8/24/1999	200	11	1	13	1
11.9	8/25/1999	200	12	2	16	-
12.1	8/25/1999	200	10	10	11	22
12.3	8/25/1999	200	18	3	21	3
12.5	8/25/1999	230	24	0	34	-
	2000					
10.4	9/18/2000	140	29	4	31	4
10.6	9/18/2000	200	19	2	25	2
10.8	9/18/2000	200	30	2	32	2
11.0	9/18/2000	200	27	5	36	5
11.1	9/19/2000	158	18	13	27	19
11.3	9/19/2000	200	24	18	27	24
11.5	9/19/2000	200	11	3	23	7
11.7	9/19/2000	200	15	3	21	6
11.9	9/19/2000	200	10	5	20	10
12.1	9/20/2000	200	16	4	24	9
12.3	9/20/2000	200	14	2	23	3
12.5	9/20/2000	230	10	2	17	3

1/ Stream Km are stream kilometers up from the mouth of Muskrat Creek at the Boulder River measured from a 1:24,000 scale USGS map sheet.

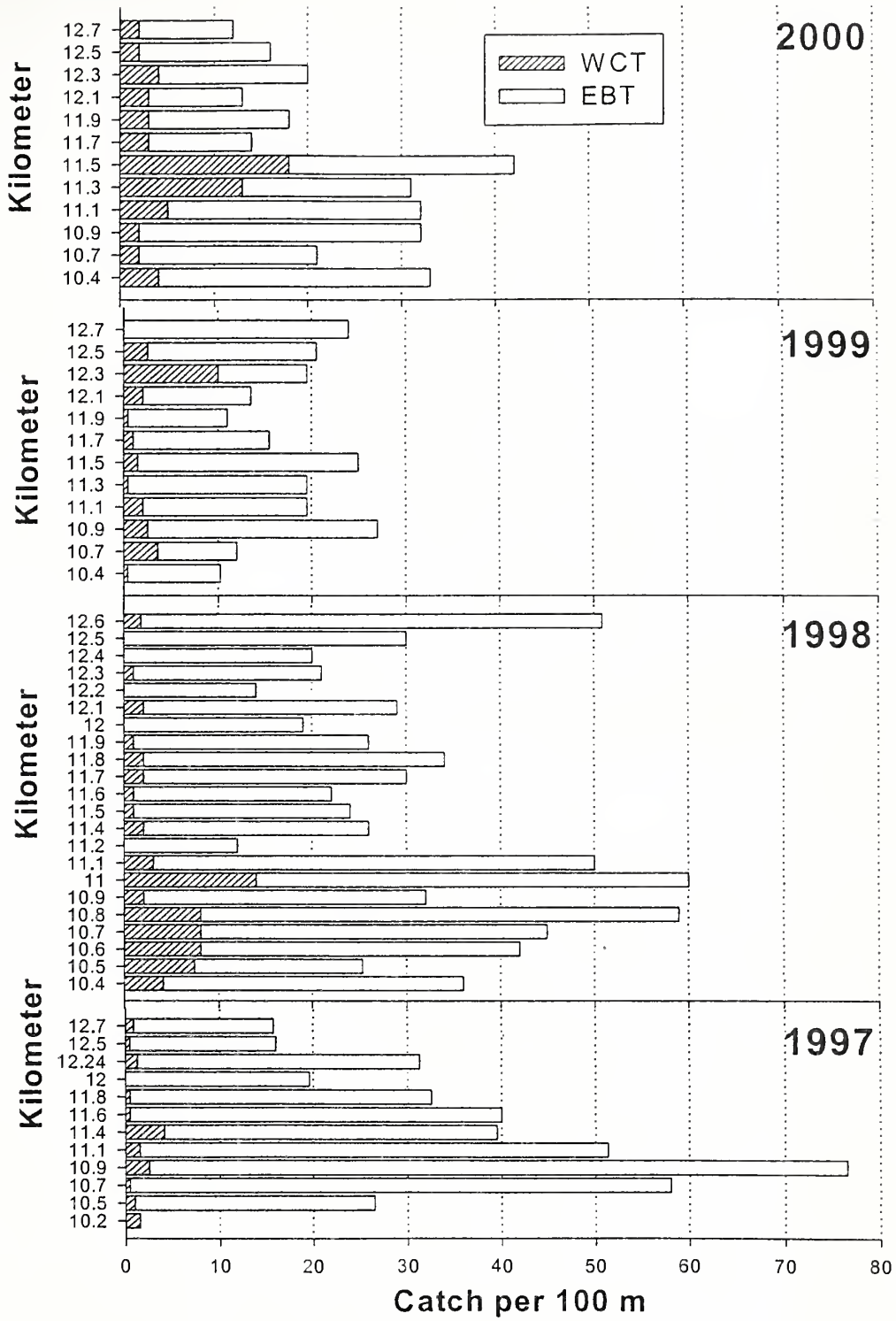

Figure 3. Catch of westslope cutthroat (WCT) and brook (EBT) trout 75 mm and longer per 100 m of stream length in Muskrat Creek from 1997 to 2000 by stream kilometer (upstream from mouth).

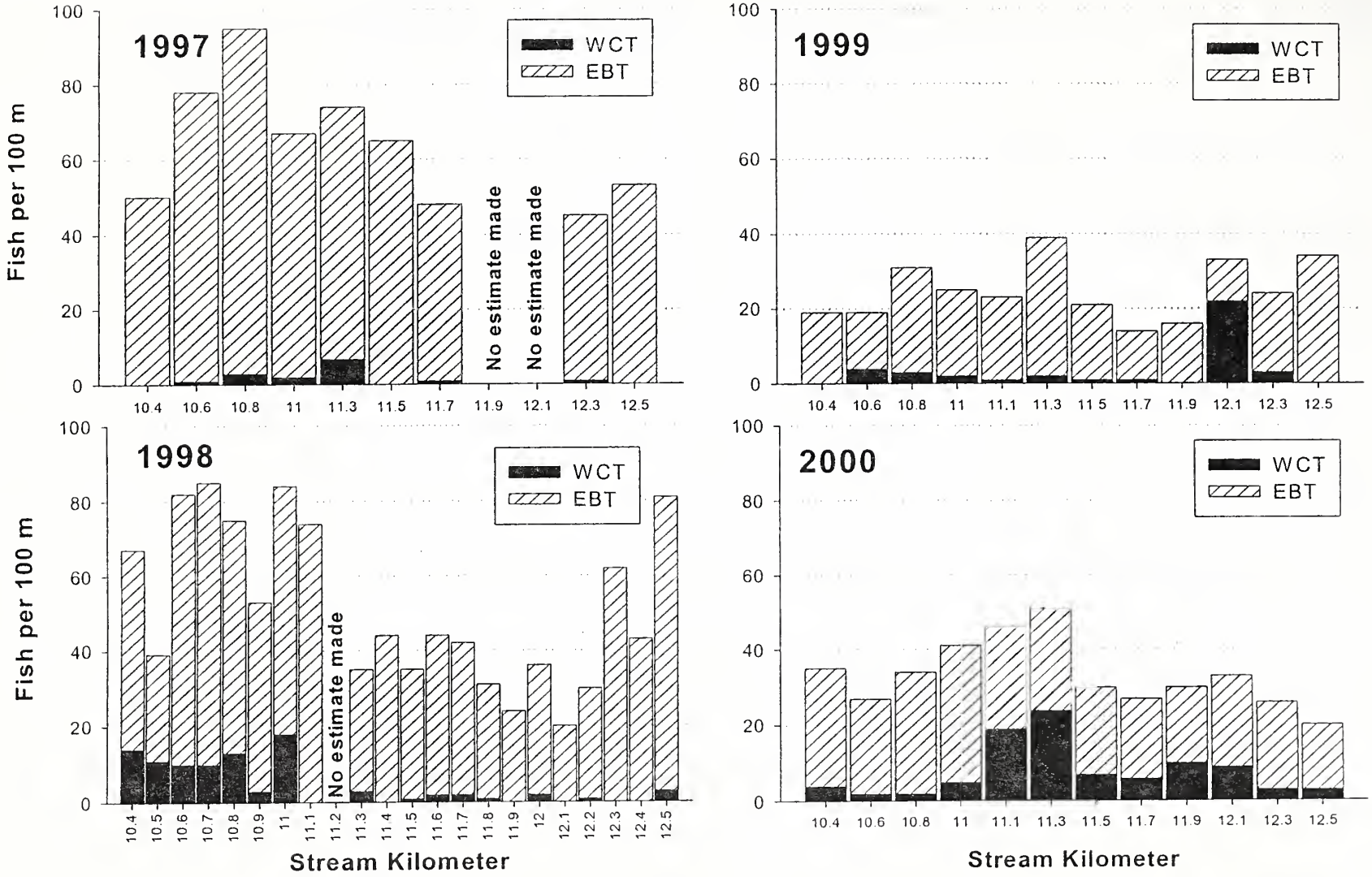

Figure 4. Estimates of westslope cutthroat trout (WCT) and brook trout (WBT) 75 mm and longer in Muskrat Creek from 1997 to 2000 by stream kilometer (above mouth).

Table 2. Total estimated number and total number of westslope cutthroat trout (WCT) and brook trout (EBT) 75 mm and longer captured in Muskrat Creek from the constructed barrier up to the natural barrier from 1997 to 2000.

	Total Estimate		Total Captured	
Year	EBT	WCT	EBT	WCT
1997	1254	32	1114	46
1998	1015	99	914	106
1999	513	74	489	79
2000	585	173	563	166

Since all WCT that were released above the natural barrier in 1997 and 1998 had their adipose fin removed, we have been able to monitor whether any of these translocated WCT moved back down below this natural barrier. We did not capture any translocated, adipose fin clipped, WCT during 1998 or 1999; however, we did recapture a 156 mm long adipose-clipped WCT in 2000 about 0.5 km below the natural barrier. We speculate that the extremely low stream flows experienced during the drought of 2000 may have led to this fish moving downstream seeking areas with higher flows. A positive aspect of recapturing this fish is that we know it survived the translocation and likely remained near its relocation site for at least one year.

Brook trout translocated below the constructed barrier also had their adipose fins removed during 1999 and 2000. In addition, brook trout captured below the constructed barrier also had their adipose fins clipped from 1998 through 2000. We recaptured a single adipose fin-clipped brook trout (178 mm in length) above the constructed barrier in 1999 and three adipose fin-clipped brook trout (117, 181, and 189 mm in length) in 2000. At this time we are uncertain whether these recaptured brook trout had escaped from our holding facility, located near the mouth of Nursery Creek, or whether they moved over the constructed barrier, either on their own or were moved by anglers. The presence of the smallest (117 mm) brook trout suggests that these fish likely escaped from our holding facilities after being clipped. We also know that one brook trout clipped during 1999 was accidently dropped into the stream immediately after being clipped.

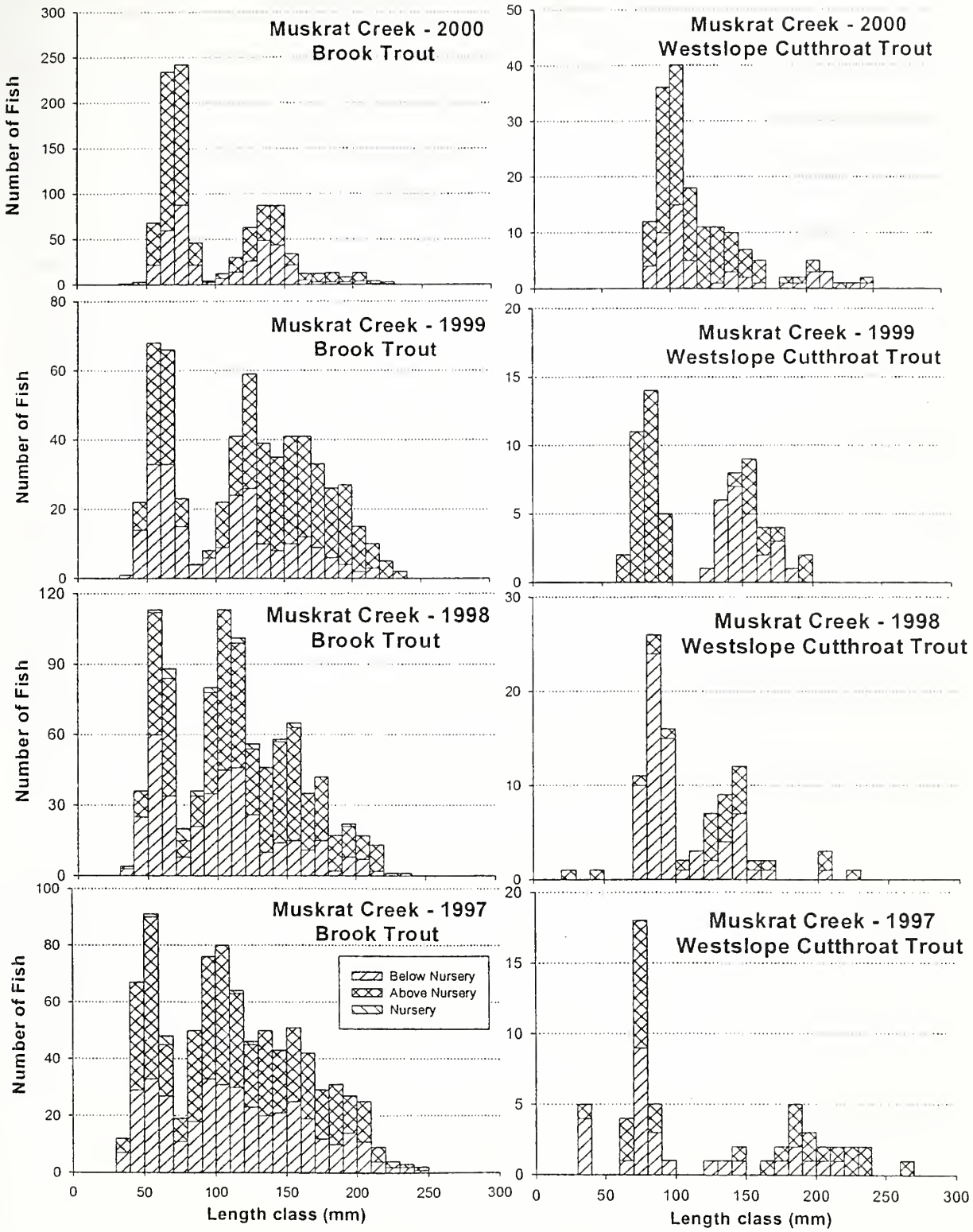

Figure 5. Length frequency histograms for brook trout (left column) and westslope cutthroat trout (right column) from 1997 (bottom) through 2000 (top) captured in Muskrat Creek below and above Nursery Creek, and in Nursery Creek.

Conclusions and Recommendations

Based on information summarized to date, it appears that electrofishing removals of brook trout have provided some relief to the WCT population, especially for recruitment of young age classes into the population. However, electrofishing removal of brook trout has not been 100% effective and probably needs to be repeated at a minimum of two to three year intervals to keep brook trout populations low enough to increase survival of young WCT. We recommend that some type of piscicide treatment be conducted in Muskrat Creek between the waterfall and constructed barrier, and in Nursery Creek, to permanently eliminate brook trout from this portion of the drainage. Prior to the treatment, as many WCT as possible should be captured by electrofishing and temporarily moved and held out of the treated area. Brook trout captured during this electrofishing could also be moved below the constructed barrier prior to treatment. This recommendation was formally proposed in the Environmental Assessment for the westslope cutthroat trout restoration project in the Elkhorn Mountains (Canfield and Spoon 1999).

At least some of the WCT moved into upper Muskrat Creek have remained near their release site and have reproduced successfully. Only one relocated WCT has moved back down below the waterfall where it was originally captured. This WCT moved during the drought year of 2000 and its movement was probably related to low stream flows. To date, four fin-clipped brook trout have beeen found above the constructed barrier, but we are uncertain at this time if these brook trout had actually been transported below the barrier. They may have escaped from a holding facility located above the constructed barrier.

Acknowledgements

This work was supported by the USDA Forest Service (FS), Beaverhead-Deerlodge National Forest, the "Bring Back the Natives" program, USDI Bureau of Land Management's Butte District (BLM), the Montana Cooperative Fishery Research Unit at Montana State University (MSU), the Montana Youth Conservation Corps (MYCC), and Montana Department of Fish, Wildlife and Parks (FWP). We appreciate the assistance of staff from MSU, FWP, BLM, FS, and MYCC to complete field removals of brook trout. Brian Sanborn of the Beaverhead-Deerlodge Forest and Sally Sovey and Bill Dean of the BLM's Butte District assisted with funding and fieldwork.

References

Canfield, J. and R. Spoon. 1999. Environmental assessment: westslope cutthroat trout restoration project in the Elkhorn Mountains. Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Hadley, W.F. 1981. The distribution of fishes and fish habitat in the Elkhorn Mountains portion of the Deerlodge National Forest. Prepared for Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Rieman, B., D. Lee, J. McIntyre, K.Overton, and R. Thurow. 1993. Consideration of extinction risks for salmonids. Technical Bulletin Number 14, Fish Habitat Relationships, U.S.D.A. Forest Service, Intermountain Research Station, Bosie, Idaho.

Spoon, R. and B. Shepard. 1996. Environmental assessment: introduction of westslope cutthroat trout into upper Muskrat Creek. Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Appendix A

Fish Population Estimates in Muskrat Creek 1997-1999

Table A1. Population estimates and standard errors (SE) made in Muskrat Creek from 1997 through 1999 by stream kilometer, date, species (EBT = brook trout; WCT = westslope cutthroat trout), and length group. Section lengths, estimator (number of passes to compute maximum likelihood depletion estimates), minimum and maximum length ranges of captured fish, total estimate (for fish 75 mm and longer), and estimated number of fish 75 mm and longer per 100 m of stream length and per hectare are also shown. Blank estimates indicate an estimate could not be made because because catches did not decrease on subsequent capture passes.

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
10.30	07/21/2000	60.0	EBT	60	21	50	103	247	72	120	
			2	(6.8)	(4.7)	(1.9)			(4.2)	(7.0)	
10.40	09/08/1998	100.0	EBT	186	33	19	77	212	53	53	1514
			3	(17.1)	(1.1)	(3.2)			(2.9)	(2.9)	
10.40	09/08/1998	100.0	WCT	0	12	1	80	167	14	14	400
			3	(0.0)	(4.2)	(0.0)			(5.6)	(5.6)	
10.40	08/23/1999	140.0	EBT	83	25	2	75	157	27	19.2	
			2	(8.7)	(1.2)	(0.0)			(1.1)	(0.8)	
10.40	09/18/2000	140.0	WCT	0	0	5	201	245	5	3.57	198
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
10.40	09/18/2000	140.0	EBT	5	32	11	76	173	43	30.7	1706
			2	(0.0)	(0.2)	(0.3)			(0.3)	(0.2)	
10.50	09/02/1997	200.0	EBT	44	73	24	76.19	228.	100	50	1667
			2	(4.4)	(10.1)	(11.3)			(15.8)	(7.9)	
10.50	09/02/1997	200.0	WCT	0	0	--	180.3	215.	--	--	
			2	(0.0)	(0.0)						
10.50	09/08/1998	150.0	EBT	38	33	9	92	202	42	28	800
			3	(9.7)	(2.6)	(0.5)			(2.4)	(1.6)	

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
10.50	09/08/1998	150.0	WCT	0	16	0	81	149	16	10.6	305
			3	(0.0)	(0.9)	(0.0)			(0.9)	(0.6)	
10.50	09/18/2000	200.0	WCT	0	1	3	147	215	4	2	111
			2	(0.0)	(0.0)	(0.7)			(0.6)	(0.3)	
10.50	09/18/2000	200.0	EBT	--	39	9	75	210	49	24.5	1361
			2		(1.8)	(0.8)			(2.4)	(1.2)	
10.60	09/08/1998	100.0	WCT	1	10	0	80	131	10	10	286
			2	(0.0)	(0.7)	(0.0)			(0.7)	(0.7)	
10.60	09/08/1998	100.0	EBT	41	71	8	87	195	72	72	2057
			2	(2.8)	(26.6)	(0.4)			(16.2)	(16.2)	
10.70	09/02/1997	200.0	EBT	104	114	39	80	218	154	77	2567
			2	(18.9)	(4.8)	(1.8)			(5.3)	(2.6)	
10.70	09/02/1997	200.0	WCT	5	1	0	87	87	1	0.5	17
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
10.70	09/08/1998	100.0	EBT	60	77	4	76	173	75	75	2143
			2	(17.9)	(21.3)	(0.0)			(14.7)	(14.7)	
10.70	09/08/1998	100.0	WCT	1	10	0	75	135	10	10	286
			2	(0.0)	(0.8)	(0.0)			(0.8)	(0.8)	
10.70	08/23/1999	200.0	WCT	0	2	6	136	175	8	4	
			2	(0.0)	(0.0)	(0.5)			(0.4)	(0.2)	
10.70	08/23/1999	200.0	EBT	--	19	10	108	219	29	14.5	
			2		(6.9)	(0.7)			(5.2)	(2.6)	
10.70	09/18/2000	200.0	EBT	12	55	8	75	200	63	31.5	1750
			2	(1.1)	(0.4)	(0.0)			(0.4)	(0.2)	

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
10.70	09/18/2000	200.0	WCT 2	0 (0.0)	2 (0.0)	2 (0.0)	136	200	4 (0.0)	2 (0.0)	111
10.80	09/08/1998	100.0	EBT 2	48 (10.0)	53 (1.7)	9 (0.8)	79	210	62 (1.8)	62 (1.8)	1771
10.80	09/08/1998	100.0	WCT 2	0 (0.0)	12 (2.7)	1 (0.0)	78	205	13 (2.6)	13 (2.6)	371
10.90	09/02/1997	200.0	WCT 2	1 (0.0)	5 (0.0)	--	78	197	6 (0.5)	3 (0.2)	94
10.90	09/02/1997	200.0	EBT 2	108 (10.7)	135 (3.6)	45 (0.7)	80	239	183 (3.4)	91.5 (1.7)	2859
10.90	09/08/1998	100.0	EBT 2	17 (1.2)	38 (3.6)	--	88	223	50 (6.7)	50 (6.7)	1429
10.90	09/08/1998	100.0	WCT 2	0 (0.0)	3 (0.8)	0 (0.0)	78	93	3 (0.8)	3 (0.8)	86
10.90	08/23/1999	200.0	WCT 2	0 (0.0)	4 (0.0)	1 (0.0)	125	154	5 (0.0)	2.5 (0.0)	114
10.90	08/23/1999	200.0	EBT 2	122 (7.7)	36 (0.7)	19 (0.5)	100	214	55 (0.9)	27.5 (0.5)	1250
10.90	09/18/2000	200.0	WCT 2	0 (0.0)	6 (0.0)	3 (0.0)	107	206	9 (0.0)	4.5 (0.0)	250
10.90	09/18/2000	200.0	EBT 2	22 (2.0)	58 (2.5)	12 (1.1)	75	225	72 (3.5)	36 (1.8)	2000
11.00	09/08/1998	100.0	WCT 2	0 (0.0)	16 (1.2)	2 (0.0)	78	157	18 (1.1)	18 (1.1)	514

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.00	09/08/1998	100.0	EBT 2	36 (14.5)	53 (5.6)	14 (0.6)	84	212	66 (4.9)	66 (4.9)	1886
11.10	09/03/1997	265.0	WCT 2	--	6 (1.1)	0 (0.0)	76	149	6 (1.1)	2.26 (0.4)	71
11.10	09/03/1997	265.0	EBT 2	278 (19.5)	137 (6.9)	39 (0.3)	80	245	173 (5.1)	65.2 (1.9)	2040
11.10	09/08/1998	100.0	EBT 2	32 (7.4)	56 (3.3)	--	82	213	74 (6.9)	74 (6.9)	2114
11.10	09/08/1998	100.0	WCT 2	0 (0.0)	--	0 (0.0)	77	140	--	--	
11.10	08/23/1999	200.0	EBT 2	147 (32.4)	28 (2.0)	17 (0.8)	76	215	46 (2.5)	23 (1.3)	
11.10	08/23/1999	200.0	WCT 2	0 (0.0)	2 (0.0)	2 (0.0)	135	162	4 (0.0)	2 (0.0)	
11.10	09/19/2000	158.0	EBT 3	75 (3.9)	38 (1.7)	5 (0.0)	75	211	43 (1.5)	27.2 (1.0)	1512
11.10	09/19/2000	158.0	WCT 3	0 (0.0)	30 (1.7)	0 (0.0)	83	116	30 (1.7)	18.9 (1.1)	1055
11.20	09/08/1998	116.0	EBT 2	10 (0.8)	--	--	90	215	--	--	
11.20	09/08/1998	116.0	WCT 2	0 (0.0)	--	0 (0.0)	136	136	--	--	
11.20	09/19/2000	200.0	WCT 3	0 (0.0)	47 (0.9)	0 (0.0)	83	139	47 (0.9)	23.5 (0.4)	1469

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.20	09/19/2000	200.0	EBT	37	44	10	75	210	54	27	1688
			3	(1.8)	(0.3)	(0.1)			(0.3)	(0.2)	
11.30	09/09/1998	100.0	EBT	7	23	9	89	199	32	32	1067
			2	(0.0)	(2.0)	(0.8)			(2.1)	(2.1)	
11.30	09/09/1998	100.0	WCT	0	3	0	107	145	3	3	100
			2	(0.0)	(0.8)	(0.0)			(0.8)	(0.8)	
11.30	08/24/1999	200.0	EBT	108	24	20	110	221	44	22	
			2	(14.2)	(0.7)	(0.8)			(1.0)	(0.5)	
11.30	08/24/1999	200.0	WCT	0	0	1	155	155	1	0.5	
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
11.40	09/03/1997	200.0	WCT	5	10	5	76.19	238.	14	7	212
			3	(1.2)	(4.7)	(0.4)			(2.5)	(1.2)	
11.40	09/03/1997	200.0	EBT	169	105	32	78.69	223.	133	66.5	2015
			3	(43.0)	(11.3)	(0.8)			(7.8)	(3.9)	
11.40	09/09/1998	100.0	EBT	39	36	5	91	177	44	44	1467
			2	(5.4)	(6.9)	(1.2)			(9.4)	(9.4)	
11.40	09/09/1998	100.0	WCT	0	--	--	126	158	--	--	
			2	(0.0)							
11.40	09/19/2000	200.0	WCT	0	14	1	86	152	14	7	438
			3	(0.0)	(3.8)	(0.0)			(2.4)	(1.2)	
11.40	09/19/2000	200.0	EBT	42	39	8	75	208	46	23	1438
			3	(31.9)	(6.1)	(0.5)			(4.8)	(2.4)	
11.50	08/05/1993	79.5	EBT	11	109	13	75.75	224.	124	155.	4727
			2	(0.3)	(24.1)	(2.6)			(24.1)	(30.3)	

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.50	08/05/1993	79.5	WCT 2	0 (0.0)	4 (1.4)	2 (0.0)	104.0	179.	6 (1.1)	7.54 (1.4)	229
11.50	09/09/1998	100.0	WCT 2	0 (0.0)	1 (0.0)	0 (0.0)	130	130	1 (0.0)	1 (0.0)	33
11.50	09/09/1998	100.0	EBT 2	23 (0.5)	17 (1.2)	16 (5.6)	100	220	34 (4.8)	34 (4.8)	1133
11.50	08/24/1999	200.0	WCT 2	0 (0.0)	1 (0.0)	2 (0.0)	144	177	3 (0.0)	1.5 (0.0)	
11.50	08/24/1999	200.0	EBT 2	--	42 (6.2)	31 (2.8)	108	217	74 (6.9)	37 (3.5)	
11.60	09/03/1997	200.0	EBT 2	350 (51.9)	116 (15.7)	20 (0.5)	77	212	130 (10.8)	65 (5.4)	2167
11.60	09/09/1998	100.0	WCT 2	0 (0.0)	2 (0.0)	0 (0.0)	130	139	2 (0.0)	2 (0.0)	67
11.60	09/09/1998	100.0	EBT 2	60 (5.2)	27 (8.4)	17 (0.5)	83	207	42 (4.3)	42 (4.3)	1400
11.60	09/19/2000	200.0	EBT 3	28 (2.7)	41 (1.5)	2 (0.0)	75	156	42 (1.1)	21 (0.5)	1313
11.60	09/19/2000	200.0	WCT 3	0 (0.0)	12 (2.5)	0 (0.0)	91	145	12 (2.5)	6 (1.3)	375
11.70	09/09/1998	100.0	WCT 2	0 (0.0)	1 (0.0)	1 (0.0)	125	208	2 (0.0)	2 (0.0)	67
11.70	09/09/1998	100.0	EBT 2	9 (0.4)	28 (1.1)	11 (0.7)	87	202	40 (1.8)	40 (1.8)	1333

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
11.70	08/24/1999	200.0	EBT	37	17	22	102	231	40	20	
			2	(3.7)	(1.2)	(2.0)			(2.8)	(1.4)	
11.70	08/24/1999	200.0	WCT	0	0	2	156	196	2	1	
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
11.80	09/03/1997	200.0	EBT	23	81	11	76	210	93	46.5	1409
			2	(0.2)	(5.3)	(1.1)			(5.7)	(2.9)	
11.80	09/03/1997	200.0	WCT	1	1	0	78	78	1	0.5	15
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
11.80	09/09/1998	100.0	WCT	0	1	0	140	140	1	1	33
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
11.80	09/09/1998	100.0	EBT	--	24	6	87	175	30	30	1000
			2		(0.7)	(1.1)			(1.1)	(1.1)	
11.80	09/19/2000	200.0	WCT	0	14	6	111	222	19	9.5	594
			3	(0.0)	(3.8)	(0.1)			(2.0)	(1.0)	
11.80	09/19/2000	200.0	EBT	18	30	8	75	188	39	19.5	1219
			3	(4.7)	(3.6)	(1.1)			(4.2)	(2.1)	
11.90	09/09/1998	100.0	EBT	8	17	7	100	172	24	24	800
			2	(3.2)	(1.2)	(0.4)			(1.2)	(1.2)	
11.90	08/24/1999	200.0	EBT	18	14	12	94	214	26	13	
			2	(0.8)	(0.9)	(0.7)			(1.1)	(0.6)	
11.90	08/24/1999	200.0	WCT	0	0	1	170	170	1	0.5	
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
12.00	09/09/1998	100.0	WCT	0	2	0	90	126	2	2	67
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
12.00	09/09/1998	100.0	EBT 2	2 (0.0)	24 (1.9)	10 (0.3)	95	204	34 (1.7)	34 (1.7)	1133
12.00	09/20/2000	200.0	EBT 3	71 (5.9)	39 (2.5)	10 (0.1)	75	225	48 (1.7)	24 (0.9)	1500
12.00	09/20/2000	200.0	WCT 3	0 (0.0)	23 (30.1)	3 (0.0)	110	161	17 (5.1)	8.5 (2.5)	531
12.10	09/09/1998	100.0	WCT 2	1 (0.0)	--	0 (0.0)	141	141	--	--	
12.10	09/09/1998	100.0	EBT 2	--	15 (2.3)	5 (0.5)	93	206	20 (2.2)	20 (2.2)	571
12.10	08/25/1999	200.0	EBT 2	6 (0.5)	10 (0.3)	22 (3.3)	104	223	31 (2.1)	15.5 (1.1)	
12.20	09/09/1998	100.0	EBT 2	--	16 (3.9)	13 (0.6)	94	215	29 (2.9)	29 (2.9)	967
12.20	09/09/1998	100.0	WCT 2	0 (0.0)	0 (0.0)	1 (0.0)	162	162	1 (0.0)	1 (0.0)	33
12.20	09/20/2000	200.0	EBT 3	67 (1.7)	37 (3.4)	9 (0.5)	75	198	46 (3.1)	23 (1.6)	1438
12.20	09/20/2000	230.0	WCT 3	0 (0.0)	2 (0.0)	3 (0.3)	115	242	6 (0.4)	2.60 (0.2)	163
12.20	09/20/2000	200.0	WCT 3	0 (0.0)	3 (0.7)	3 (0.7)	112	185	6 (1.1)	3 (0.5)	188
12.20	09/20/2000	230.0	EBT 3	73 (2.2)	28 (2.9)	12 (0.5)	75	225	40 (2.5)	17.3 (1.1)	1087

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group < 75 mm	75-150 mm	150 + mm	Length Range (mm) Min	Max	Total estimate (SE)	Estimated number/ 100 m	Hectare
12.30	09/09/1998	100.0	WCT	1	0	0	75		0	0	0
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
12.30	09/09/1998	100.0	EBT	4	72	5	88	177	62	62	2067
			2	(0.0)	(76.1)	(0.5)			(34.5)	(34.5)	
12.30	08/25/1999	200.0	EBT	4	10	11	102	209	21	10.5	
			2	(0.6)	(0.3)	(0.3)			(0.5)	(0.3)	
12.30	08/25/1999	200.0	WCT	--	44	1	75	193	44	22	
			2		(15.1)	(0.0)			(13.4)	(6.7)	
12.40	09/09/1998	100.0	EBT	5	26	16	93	218	43	43	1433
			2	(1.2)	(3.2)	(0.9)			(3.5)	(3.5)	
12.50	09/04/1997	200.0	WCT	0	0	1	231	231	1	0.5	14
			2	(0.0)	(0.0)	(0.0)			(0.0)	(0.0)	
12.50	09/04/1997	200.0	EBT	--	120	27	83	215.	127	63.5	1764
			2		(200.1)	(8.4)			(88.7)	(44.3)	
12.50	09/09/1998	112.0	WCT	0	0	3	150	225	3	2.67	89
			2	(0.0)	(0.0)	(0.7)			(0.7)	(0.7)	
12.50	09/09/1998	112.0	EBT	1	44	46	102	236	87	77.6	2589
			2	(0.0)	(13.5)	(2.5)			(7.7)	(6.9)	
12.50	08/25/1999	200.0	WCT	1	5	1	79	153	6	3	
			2	(0.0)	(0.5)	(0.0)			(0.5)	(0.3)	
12.50	08/25/1999	200.0	EBT	24	19	24	102	227	42	21	
			2	(7.3)	(2.3)	(0.2)			(1.1)	(0.6)	
12.60	08/05/1993	68.9	EBT	0	21	3	75.75	169.	24	34.8	917
			2	(0.0)	(2.1)	(0.7)			(2.2)	(3.2)	

Table A1. (Continued).

Stream km	Date	Section length (m)	Species Estimator	Estimate (SE) by Length Group			Length Range (mm)		Total estimate (SE)	Estimated number/	
				< 75 mm	75-150 mm	150 + mm	Min	Max		100 m	Hectare
12.70	09/04/1997	235.0	EBT 2	--	--	30 (2.9)	82	243	161 (124.)	68.5 (53.1)	1903
12.70	09/04/1997	235.0	WCT 2	0 (0.0)	0 (0.0)	3 (0.7)	185	265	3 (0.7)	1.27 (0.3)	35
12.70	08/25/1999	230.0	EBT 2	14 (0.6)	23 (3.2)	54 (3.2)	76	235	78 (4.8)	33.9 (2.1)	

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